



## **Illustrated Work Instructions Improve AH-64D Apache Longbow Quality Assurance Surveillance**

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**T**oday at Boeing Mesa, a picture is worth a thousand words. A quick glance through any Defense Contract Management Agency (DCMA) Risk Management Plan will prove out this old adage. Taking advantage of readily available technology, DCMA Quality Assurance Specialists (QAS) have recently incorporated digital photography into their assembly surveillance plans for the AH-64D Apache Longbow.

These improved factory-floor tools bring significant advantage to the quality surveillance work environment including high definition and detail, ease of use and effective/efficient personnel cross-training capability. The result: significantly improved levels of on-aircraft quality oversight. At Boeing Mesa, all aircraft Safety of Flight (SOF) installations and procedures are candidates for this enhanced surveillance approach. For DCMA QAS personnel, complete assembly coverage is the ultimate goal, a goal that will be realized in the very near-term.

Boeing has used this type of work aid since 1999. The AH-64A Apache had previously been assembled, and quality-inspected, without the benefit of these types of tools. However, affordable availability of high-quality digital photography has rapidly transformed assembly-line operations and the quality inspection functions associated with them. Initially used for critical and complex assemblies and procedures, illustrated work instructions (IWIs) are now available to Boeing assembly personnel for most tasks performed on aircraft production lines. Acknowledging the benefits that these tools provide to assembly line operations, DCMA QAS personnel are adapting these same references for the government's quality inspection function.

Until recently, DCMA Boeing Mesa's QAS personnel relied on AH-64 manufacturing engineering plans, blueprints and drawings, written work instructions and factory-floor experience to perform aircraft assembly surveillance. Combined with extensive

aircraft-specific knowledge, this approach ensured effective surveillance of most aircraft assembly tasks. However, no approach is completely foolproof and this one proved no exception. DCMA Boeing Mesa's wake-up call came in spring 2002.

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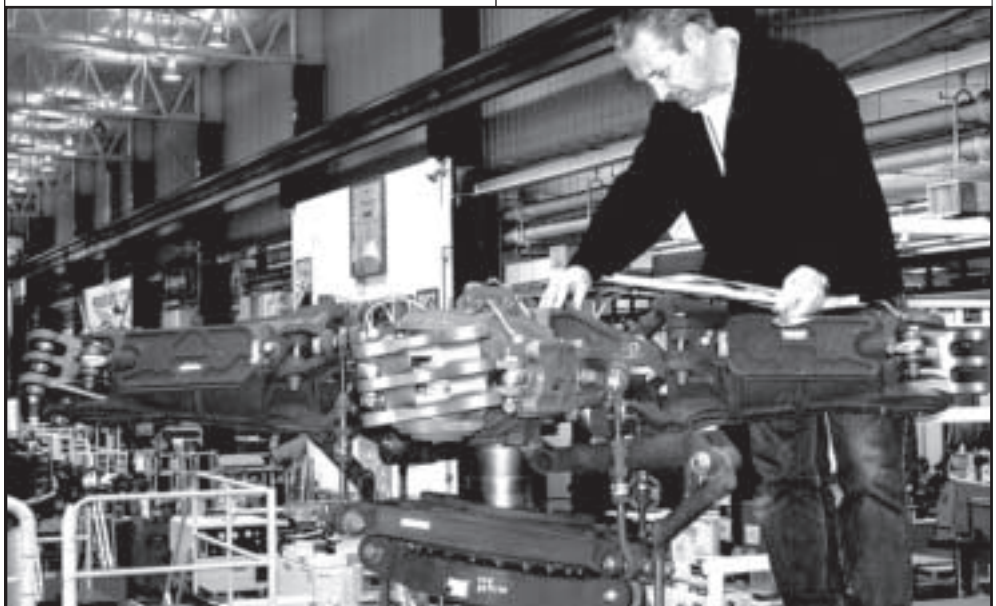
On April 20, 2002, 1st Battalion, 2nd Aviation Regiment, Camp Page, Korea, experienced a potentially catastrophic in-flight event while conducting AH-64D aerial gunnery operations. As the aircraft maneuvered into firing position, it began an uncommanded right yaw. Confirming that the turn was not copilot/gunner-induced and that neither station could move the pedals, the crew determined that they were experiencing a fixed-pitch

tail rotor emergency. Pulling just enough power for stabilized, level flight, the crew flew the stricken aircraft to a Republic of Korea airfield and landed without further incident.

Upon inspection, the aircraft's directional control system revealed full pedal travel and no evidence of binding or foreign object damage that could have restricted pedal travel. However, when unit inspectors removed the automatic roller detent decoupler (ARDD) access panel on the pilot's station floor, it was confirmed that the bonding jumper cable was in close proximity to the ARDD assembly. Further inspection revealed that, though not presently fouled, the cable had a peculiar bend formed in it. Subsequently, the gun turret was removed and the directional ARDD assembly was closely inspected. The investigation concluded that the jumper cable had migrated and temporarily lodged within the assembly, fouling the ARDD and restricting full pedal travel.

Boeing's on-site field support representative issued a "flash mishap report," which described the incident and its suspected root cause. At the Boeing Mesa facility in Arizona, all production line aircraft were immediately inspected. The inspection results were noteworthy for several reasons. First, it was determined that the jumper cable routing was clearly problematic

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All SOF inspections are covered by this enhanced approach to quality assurance surveillance.



Digital photography greatly aids task performance in all quality areas.



(i.e., allowed cable travel). Furthermore, this condition was found to be “not to print.” Most significantly, the condition was present on 20 of the 22 aircraft inspected. Inspectors found that the jumper cables had been improperly routed beneath or behind the ARDD assembly. Blueprints depicted that cables should be routed in front of and above the assembly.

The follow-on review revealed the source of the assembly procedure error. Although assembler and quality inspector misinterpretation were clearly factors in this shortcoming, the blueprint/drawing also played a role. Simply put, the drawing did not adequately depict the true/correct jumper cable routing for the ARDD assembly. Though in fact installed incorrectly, the cable routing “looked right” to the trained eye and appeared to have more than adequate clearance past the ARDD assembly. Under static factory assembly conditions, and follow-on functional checks, the potential for cable travel and subsequent fouling within the ARDD assembly occurred to

no one. Government and contractor personnel agreed an immediate solution was required to correct this fault.

Fortunately, IWIs were already in use for other complex assembly tasks on the Boeing assembly line. Recognizing the utility of IWIs from both a production quality and lean manufacturing standpoint, the company had extensively integrated high-fidelity digital photos into its assembly operations. Supplemented by imbedded text instructions, notes and cautions, these illustrated instructions were superior in many ways to any written descriptions or the actual technical drawings.

Though IWIs had not yet been migrated to all areas of the assembly process, rapidly creating reference tools for the ARDD assembly procedure was neither difficult nor time-consuming. Within hours of the factorywide aircraft inspection, an IWI was in place on the Apache Longbow assembly line that depicted the correct routing procedures for the ARDD jumper cables. Using this enhanced visual tool as a reference, the risk of further installation errors was significantly mitigated.

Within this pretext, DCMA QAS personnel quickly seized on the idea of using modified IWIs to support their areas of assembly surveillance responsibility. Emphasizing capturing the critical characteristics associated with SOF-related installations, DCMA QAS personnel modified, and in some instances, created from scratch, a series of digital photo inspection tools. With inspection-related notes, cautions and attention-grabbing icons, these aids are imbedded in nearly all SOF-related procedures performed at the Mesa facility. DCMA QAS personnel have fully integrated these highly detailed references into their Risk Management Plans, with each

SOF procedure being accompanied by at least one photographic depiction.

Extensive use of highly detailed inspection aids, in conjunction with traditional assembly inspection references, is now the standard at DCMA Boeing Mesa. By recognizing, then leveraging Boeing’s successful practices, DCMA modified and integrated the necessary tools and procedures to fit within the assembly inspection and surveillance approach. DCMA Boeing Mesa has taken AH-64D quality assurance surveillance to the next level. Seeking continuous improvement, the overriding goal is to provide the very best products to Army aviators. Initiatives such as this will ensure that this goal is met.

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